REMARKS

Claims 1-5 and 8-18, as amended, remain herein. Claims 1, 2, 8, 11 and 16 have been amended for clarity. New claims 17 and 18 have been added. Support for the amendments and the new claims may be found throughout the specification (see, e.g., original claims and Examples 1-6). Claims 1, 2 and 16 have also been amended to delete "predominantly" from the claim language because it may unnecessarily limit the scope of applicants' claims by suggesting that the electron mobility of the host material is numerically higher than the hole mobility. The scope of applicants' claims is not limited to any specific hole mobility of the host material so long as the electron mobility is 10^{-5} $cm^2/V.s$ or greater.

Applicants attorneys thank Examiner Crouse for the interview conducted October 14, 2009. During the interview, applicants' attorneys argued the patentability of applicants' claims over the cited references. The arguments made during the interview are included in the remarks below herein.

1. Applicants' claims are patentable over Shirasaki et al. U.S. Patent 5,834,894 in view of Okada et al. US Patent Application Publication 2002/055014, further in view of Matsushima et al., *Current Applied Physics* **2005**, 5, 305-308; Bernede et al., SCELL-2004 International Conference on Physics, Chemistry and Engineering of Solar Cells, Badajoz, Spain (2005), 87, 261-270; and Wu et al., Advanced Materials (2008), 20, 2359-2364..

Shirasaki does not disclose applicants' claimed organic electroluminescence device. Shirasaki uses a fluorescent not a phosphorescent dopant. A person of ordinary skill in this art

would know that fluorescent and phosphorescent dopants are not directly substitutable. As explained in applicants' specification, a hole blocking layer was typically used in phosphorescent devices to prevent the quench of triplet excited states and to achieve sufficient device efficiency:

> However, it was found that the conventional constructions for electron injection have problems. Namely, because the hole blocking layer has large energy gap, and because it works with great resistance as an energy barrier for charge injection transport from the other layer, the driving voltage elevated. Further, although many compounds used for the hole blocking layer held favorable hole barrier capability, they tended to deteriorate, and failed to provide an organic EL device with long lifetime.
>
> ...
>
> As the result of intensive researches and studies to achieve the above object by the present inventors, the first aspect of the present invention provides an organic EL device, which comprises an light emitting layer consisting of at least phosphorescent light emitting material and a host material, a cathode, and an electron injecting layer adhered to the light emitting layer and at the same time sandwiched between the light emitting layer and the cathode, without employing any hole blocking layer. Further, the first aspect of the invention made the energy gap of electron transporting material in electron injecting layer smaller than that of the host material in the light emitting layer. According to the conventional comprehension by the persons skilled in the art, the above settlement will let the electron injecting layer deactivates the excitation state generated in the light emitting layer and only the EL devices with extremely low efficiency will be provided. In the present invention, however, enabling the light emitting layer electron transporting, an electron-hole recombination zone will separate from the interface between the electron injecting layer and the light emitting layer resulting in avoidance of deactivation. Besides, an EL device with high efficiency without the use of the hole blocking layer in the conventional organic EL device is provided by making the ionization potential of the host material 5.9 eV or lower in order to enable holes easily inject into the host material in the light emitting layer. Further, the driving voltage can be decreased because the holes are injected into the host material in the light emitting layer thereby allowing the transportation, and an organic EL device with long lifetime can be obtained because any hole blocking layer that easily deteriorates is not employed. Furthermore, the organic EL device is easily producible because its constitution became simple. Moreover, it was ensured that the energy gap of electron transporting material in electron injecting layer smaller than that of the host material in the light emitting layer has also an effect of promoting injection of electrons from cathode as well as decreasing the driving voltage.

Applicants' specification at page 4, lines 8-14 and page 5, line 16 to page 6, line 21 (emphasis added here). See also Okada Example 1 at paragraph [0236] (showing the use of a hole blocking layer comprising bathocuproine); Baldo et al. US Patent 6,097,147 at column 2, lines 1-26 and

column 3, lines 22-60 (discussing the issues with phosphorescent devices and the use of a hole blocking layer); and Thompson et al. US Patent 7,078,113 at column 2, line 55 to column 3, line 6 (discussing the need for a blocking layer to maximize the efficiency of electro-phosphorescent devices). Applicants' claimed invention, on the other hand eliminates the need to use a hole blocking layer.

In addition, neither Shirasaki nor Okada requires that the host material have an ionization potential of 5.9 eV or less and an electron mobility of 10^{-5} $cm^2/V.s$ or greater. Shirasaki discloses PVCz as the host material, which is a known hole transporting material and which has poor electron mobility or transporting properties. Okada discloses various compounds but says nothing about host materials having an ionization potential of 5.9 eV or less. In fact, some of Okada's compounds appear to have an ionization potential greater than 5.9 eV. Compare Okada compound 246 (used in Okada's device 110 (see Okada at Table 1, page 85)) with applicants' Comparative Example 6 (TPBI) which has an ionization potential of 6.7 eV (Table 1 at page 88 of applicants' specification). As demonstrated in applicants' specification, a host material having an ionization potential higher than 5.9 yields inferior luminance and current efficiency even at higher voltage (compare applicants' Example 5 and Comparative Example 6 in Table 1 at page 88 of applicants' specification).

Evidence of long felt but unsolved needs and failure of others (see MPEP § 2145, citing Graham v. John Deere Co., 383 U.S. 1, 17 (1966)), and evidence that the claimed invention yields unexpectedly improved properties or properties not present in the prior art (see MPEP § 2145, citing In re Dillon, 919 F.2d 688, 692-93 (Fed. Cir. 1990)), rebut alleged obviousness. Applicants' claimed invention solves a long felt problem by eliminating the need for a hole

blocking layer and yields unexpected results by achieving great efficiency of light emission without the use of a hole blocking layer (compare applicants' Example 5 and Comparative Example 6 at Table 1, page 88 of applicants' specification (showing that Comparative Example 6 required higher voltage to achieve about the same efficiency of light emission)).

Applicants' claim 2 is further patentable because it recites that a triplet energy of the electron transporting material in the electron injecting layer is smaller than that of the host material in the light emitting layer.

Applicants' claim 18 is further patentable because neither Shirasaki nor Okada discloses a host material obtained by bonding carbazolyl group or azacarbazolyl group with a pyridine or pyrimidine group, or obtained by bonding carbazolyl group or azacarbazolyl group to a pyridine or pyrimidine group via an arylene group.

Thus, applicants' claims are not obvious over Shirasaki in view of Okada. Furthermore, Shirasaki and Okada disclose nothing that would have suggested applicants' claimed invention to one of ordinary skill in the art. There is no disclosure or teaching in any of Shirasaki, Okada, or anything else in this record, that would have suggested the desirability of modifying or combining any portions thereof effectively to anticipate or suggest applicants' presently claimed invention.

2. Applicants' claims are patentable over Fujino et al. JP 2000-169448 in view of Okada as evidenced by Tanaka et al., *Japan Journal of Applied Physics* **2003**, 42, 2737-2740.

Fujino does not disclose applicants' claimed organic electroluminescence device. The Office Action of April 2, 2009 admits that Fujino does not teach a phosphorescent dopant in the

light emitting layer, and states that Okada teaches phosphorescent dopants. As explained above, a person of ordinary skill in this art would not directly substitute a fluorescent with a phosphorescent dopant.

As explained above, a hole blocking layer is typically used in phosphorescent devices to prevent the quenching of triplet excited states and to achieve sufficient device efficiency (applicants' specification at page 3, line 11 to page 4, line 14). Applicants' organic electroluminescence device eliminates the need for a hole blocking layer and achieves superior efficiency of light emission under lower voltage.

Thus, applicants' claims are not obvious over Fujino in view of Okada. Furthermore, Fujino and Okada disclose nothing that would have suggested applicants' claimed invention to one of ordinary skill in the art. There is no disclosure or teaching in any of Fujino, Okada, or anything else in this record, that would have suggested the desirability of modifying or combining any portions thereof effectively to anticipate or suggest applicants' presently claimed invention.

Accordingly, all claims 1-5 and 8-18 are now fully in condition for allowance and a notice to that effect is respectfully requested. The PTO is hereby authorized to charge/credit any fee deficiencies or overpayments to Deposit Account No. 19-4293. If further amendments would place this application in even better condition for issue, the Examiner is invited to call applicants' undersigned attorney at the number listed below.

Respectfully submitted,

STEPTOE & JOHNSON LLP

Date: October 23, 2009

Houda MORAD

Roger W. Parkhurst
Reg. No. 25,177
Houda Morad
Reg. No. 56,742

STEPTOE & JOHNSON LLP
1330 Connecticut Avenue, NW
Washington, DC 20036
Tel: 202-429-3000
Fax: 202-429-3902